

# Master Degree Program in Environmental Sciences

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## Background

The Interfaculty Graduate Environmental Sciences Program (IGESP) is a multidisciplinary field of study which leads to the Master of Sciences degree in Environmental Sciences with four possible majors: Environmental Technology, Ecosystem Management, Environmental Health, and Environmental Policy Planning.

Together, these majors ensure adequate coverage of all environmental and sustainable development issues prevailing in Lebanon and the Arab World, in their various ecological, economic, political and social dimensions.

The program has been designed to cater to the rising demand for environmental scientists in the Middle East region. The specificity of the region's environment is reflected both in the program's academic and educational perspectives.

Founded in the mid-1990s, the IGESP program, recognizing Lebanon's unique diversity – environmental, societal and cultural – also understands that various environmental problems affect the integrity of the country's ecosystems. Accordingly, IGESP adopts a holistic approach to resolving those problems, and offers a course of study designed to address both the most salient environmental issues as well as more specialized topics.

IGESP draws on the resources of various faculties/departments and provides opportunities for study and research in the field of the environment in its totality. While the program caters mostly to physical and natural sciences students, it is offered to students holding a bachelor's degree in any approved relevant discipline of engineering, natural or social science, or humanities. It provides graduates with the necessary tools to assess diversified and multidisciplinary environmental issues. The program focuses on enhancing students' research, analytical, problem-solving and critical-thinking skills by emphasizing the case study approach to learning and solving environmental problems.

Like all programmes at the American University of Beirut, IGESP is registered in the US through the New York State Education Department.

## Mission

The mission of the AUB IGESP Program is to contribute to building the environmental capacity in Lebanon and the region through human resources development as well as research and community involvement. The essence of the program lies in its interdisciplinarity. The program is firmly based on a holistic view of the environment that integrates the ecological, technical, health and socioeconomic dimensions. We aim to train creative, flexible and cross-curricular graduates capable of appreciating,

building on, and applying cutting-edge knowledge for the management of the environment. Our graduates are empowered with exceptional technical, managerial, critical evaluation, research and reporting skills.

## Vision

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The IGESP Program aspires to be the leading interdisciplinary program bridging environmental education, research and service through close partnership with academic institutions and civil society actors.

## General Information

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The degree of Master of Science (MS) in Environmental Sciences is offered with four possible majors:

- Ecosystem Management in the Faculty of Agricultural and Food Sciences (FAFS)
- Environmental Health in the Faculty of Health Sciences (FHS)
- Environmental Technology in the Maroun Semaan Faculty of Engineering and Architecture (MSFEA)
- Environmental Policy Planning in the Faculty of Arts and Sciences (FAS)

The program draws on the resources of various departments of the faculties of Agricultural and Food Sciences (FAFS), Arts and Sciences (FAS), Engineering and Architecture (MSFEA), Health Sciences (FHS) and Medicine (FM), and it provides opportunities for study and research in the general field of environment.

The program provides graduates with the necessary tools for professional practice and/or the pursuit of higher education. It is administered by an interfaculty committee that coordinates with the graduate committees of the faculties concerned.

## Criteria for Admission

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To be accepted into the program, an applicant must:

- meet general university requirements for admission to graduate study.
- be recommended by the appropriate faculty graduate committee and accepted by the Interfaculty Coordinating Committee of the program.
- provide at least two academic letters of recommendation and one other professional letter if relevant.
- submit a detailed effective statement of purpose (400-500 words) for each major indicating the purpose for pursuing graduate study in the particular field at AUB and specifying the applicant's research interests and/or practical experience in the field. Note: The statement should be oriented to the major.
- have a background that is relevant to the major.

Applicants to the program may be admitted under the following categories:

- graduate - if the average in the last 60 credits or the last two years is greater than 3.3
- graduate on probation - if the average in the last 60 credits or the last two years is less than 3.3 and greater than 3.0

Adequate preparation to take any graduate course is decided by the academic advisor and the Interfaculty Graduate Environmental Sciences Program Committee (IGESPC).

## Degree Requirements

Requirements for the degree of Master of Science in Environmental Sciences (any major), both thesis and non-thesis options, are tabulated below. The master's degree with thesis option will normally require between 20 and 24 months to be completed. In both options, the student is required to complete 30 credits of which 9 credits are core courses.

| Course   | Group | Thesis Option Credits | Non-Thesis Option Credits |
|--|-------|-----------------------|---------------------------|
| Core   | A     | 9                     | 9                         |
| Electives  | B     | 15                    | 18                        |
| Thesis   |       | 6                     |                           |
| Project  |       |                       | 3                         |
| <b>Total number of credits required for graduation</b> |       |                       | <b>30</b>                 |

Core courses, as well as basic and broad electives, are listed below. Other relevant electives not listed below may be accepted on a case-by-case basis. These courses are structured to provide students with a diversified and multidisciplinary background in environmental sciences. Students have to register for the core course offered by their faculty of concentration. Students are also required to select two other supplementary courses from the list of core courses approved by the program. Students may not select two core courses from the same faculty. Students can take other elective courses from other faculties after securing the approval of the advisor. Specific faculty/department requirements are defined under each respective faculty/department.

| Group A   | Core Courses in Environmental Sciences                   | Credits |
|---|--|---------|
| <b>One course selected from the following ECOM core courses</b> |  |         |
| ENSC 630/LDEM 630   | Natural Resources Management                             | 3       |
| LDEM 301  | Urban Greening   | 3       |
| LDEM 302  | Green Infrastructure for Resilient Landscapes and Cities | 3       |
| <b>One course selected from the following ENVH core courses</b> |  |         |
| ENSC 640/ENHL 310   | Toxicology and Environmental Health Hazards              | 3       |
| ENSC 641/ENVH 312   | Occupational Health                                      | 3       |
| ENSC 642/ENHL 314   | Environmental Management Systems                         | 3       |
| <b>One course selected from the following ENVT core courses</b> |  |         |
| CIVE 550  | Water Treatment and Laboratory                           | 3       |
| CIVE 551  | Wastewater Treatment and Laboratory                      | 3       |
| CIVE 552  | Waste Management and Treatment                           | 3       |
| CIVE 553  | Environmental Biotechnology                              | 3       |
| CIVE 555  | Air Quality Management                                   | 3       |
| CIVE 654  | Environmental Bioremediation                             | 3       |
| ENSC 600/CIVE 655   | Air Pollution and Control                                | 3       |
| <b>ENVP core course</b>   |  |         |
| ENSC 650/PSPA 316   | International Environmental Policy                       | 3       |

| <b>Group B</b>                   | <b>Examples of Major Electives</b>                          | <b>Credits</b> |
|----------------------------------|---|----------------|
| <b>1. Ecosystem Management</b>   |   |                |
| ENSC 631/LDEM 631                | Agricultural Pollution and Control                          | 3              |
| ENSC 633/LDEM 633                | Ecological Landscape Design and Planning                    | 3              |
| ENSC 634/LDEM 634                | Sustainable Landscape Planning and Management               | 3              |
| ENSC 635/LDEM 635/<br>PSPA 3446A | Political Ecology of Water                                  | 3              |
| ENSC 622/CIVE 653                | Environmental Chemistry and Microbiology                    | 3              |
| ENSC 641/ENHL 312                | Occupational Health   | 3              |
| ENSC 642/ENHL 314                | Environmental Management Systems                            | 3              |
| ENSC 652/CIVE 656                | Environmental Impact Assessment                             | 3              |
| ENSC 654                         | Physical and Biological Resources in Terrestrial Ecosystems | 3              |
| ENSC 655/AGSC 301                | Statistical Methods in Agriculture                          | 3              |
| ECON 333                         | Energy Economics and Policy                                 | 3              |
| ENSC 662/ECON 338                | Economics of Natural Resources and the Environment          | 3              |
| LDEM 300                         | Directed Study in Ecosystem Management                      | 3              |
| LDEM 301                         | Urban Greening  | 3              |
| LDEM 302                         | Green Infrastructure for Resilient Landscapes and Cities    | 3              |
| BIOL 362                         | Advanced Ecology  | 3              |
| BIOL 363                         | Population and Community Ecology                            | 3              |
| AGSC 376                         | Resource and Environmental Economics                        | 3              |
| AGSC 384                         | Political Economy of Middle East Development                | 3              |
| CIVE 648                         | Climate Change and Water Resources                          | 3              |
| CIVE 552                         | Waste Management and Treatment                              | 3              |
| ENSC 630/LDEM 630<br>CIVE 633    | Natural Resources Management                                | 3              |
| CIVE 654                         | Environmental Bioremediation                                | 3              |
| ENSC 600/CIVE 655                | Air Pollution and Control                                   | 3              |
| CIVE 659                         | Environmental and Water Conflict Management                 | 3              |
| URPL 664                         | Urban Land Use Planning                                     | 3              |
| URPL 665                         | Development and Planning Policies                           | 3              |
| <b>2. Environmental Health</b>   |   |                |
| CIVE 601                         | GIS and Geospatial Data Modeling                            | 3              |
| EPHD 300                         | Principles of Epidemiology                                  | 3              |
| PBHL 300                         | Foundations of Public Health                                | 3              |
| PBHL 310                         | Research Design   | 3              |
| EPHD 310                         | Basic Biostatistics   | 3              |
| ENSC 600/CIVE 655                | Air Pollution and Control I                                 | 3              |
| ENSC 640/ENHL 310                | Toxicology and Environmental Health Hazards                 | 3              |

| <b>2. Environmental Health</b>     |  |     |
|------------------------------------|--|-----|
| ENSC 641/ENHL 312                  | Occupational Health                                | 3   |
| ENSC 642/ENHL 314                  | Environmental Management Systems                   | 3   |
| ENSC 641/ENHL 312                  | Occupational Health                                | 3   |
| ENSC 642/ENHL 314                  | Environmental Management Systems                   | 3   |
| ENHL 301                           | Environmental Health and Sustainable Development   | 1   |
| ENHL 307                           | Food Safety  | 3   |
| ENHL 308                           | Tutorial   | 1-3 |
| ENHL 320                           | Special Topics in Environmental Risk Analysis      | 3   |
| ENSC 652/CIVE 656                  | Environmental Impact Assessment                    | 3   |
| ENSC 658/PSPA 343                  | Environmental Conflict Resolution                  | 3   |
| ENSC 661/BIOL 363                  | Population and Community Ecology                   | 3   |
| ENSC 662/ECON 338                  | Economics of Natural Resources and the Environment | 3   |
| CIVE 659                           | Environmental and Water Conflict Management        | 3   |
| <b>3. Environmental Technology</b> |  |     |
| CIVE 550                           | Water Treatment and Laboratory                     | 3   |
| CIVE 551                           | Wastewater Treatment and Laboratory                | 3   |
| CIVE 552                           | Waste Management and Treatment                     | 3   |
| CIVE 553                           | Environmental Biotechnology                        | 3   |
| CIVE 555                           | Air Quality Management                             | 3   |
| CIVE 601                           | GIS and Geospatial Data Modeling                   | 3   |
| CIVE 602                           | Experimental Design and Statistical Methods        | 3   |
| CIVE 650                           | Water and Sewage Works Design                      | 3   |
| CIVE 651                           | Processes in Water and Wastewater Treatment        | 3   |
| CIVE 652                           | Landfill Engineering Design                        | 3   |
| CIVE 653                           | Environmental Chemistry and Microbiology           | 3   |
| CIVE 654                           | Environmental Bioremediation                       | 3   |
| ENSC 600/CIVE 655                  | Air Pollution and Control                          | 3   |
| CIVE 656                           | Environmental Impact Assessment                    | 3   |
| ENSC 651/CIVE 657                  | Methods of Environmental Sampling and Analysis     | 3   |
| ENSC 611/ENHL 312                  |  | 3   |
| CIVE 751                           | Wastewater Reclamation and Reuse                   | 3   |
| CIVE 658                           | Industrial Waste Management                        | 3   |
| CIVE 659                           | Environment and Water Conflict Management          | 3   |
| CIVE 685                           | Environmentally Sustainable Renewable              | 3   |
| ENSC 602/CIVE 755                  | Air Pollution Modeling                             | 3   |
| ENSC 642/ENHL 314                  | Environmental Management Systems                   | 3   |

| <b>4. Environmental Policy Planning</b> |  |   |
|---|--|---|
| PPIA 301                                | Public Policy and Practice                             | 3 |
| PPIA 304                                | Development  | 3 |
| PPIA 305                                | Economics for Public Affairs                           | 3 |
| PPIA 306                                | Political Economy                                      | 3 |
| PPIA 307                                | Politics of Policy-Making                              | 3 |
| PPIA 308                                | Research Methods                                       | 3 |
| PPIA 309                                | Evidence, Policy and Communication                     | 3 |
| PPIA 310                                | Topics in Public Policy                                | 3 |
| PPIA 311                                | Topics in International Affairs                        | 3 |
| PSPA 312                                | Public International Law                               | 3 |
| PSPA 314                                | The UN and International Politics                      | 3 |
| PSPA 324                                | Government and Politics of Lebanon                     | 3 |
| PSPA 343/ENSC 658                       | Environmental Conflict Resolution                      | 3 |
| PSPA 345                                | Special Topics in Environmental Policy and Politics    | 3 |
| PSPA 346                                | Special Topics in Natural Resource Policy and Politics | 3 |
| PSPA 351                                | New Public Management                                  | 3 |
| PSPA 352                                | Foundations of Public Policy                           | 3 |
| PSPA 360                                | Public Policy Research and Analysis                    | 3 |
| ENSC 659/PSPA 362                       | Public Policy and Administration                       | 3 |
| PSPA 373                                | The Ethics of Public Administration                    | 3 |
| AGSC 376                                | Resource and Environmental Economics                   | 3 |
| AGSC 384                                | Political Economy of Middle East Development           | 3 |
| ECON 333                                | Energy Economics and Policy                            | 3 |
| ECON 338                                | Economics of Natural Resources and the Environment     | 3 |
| URPL 664                                | Urban Land Use Planning                                | 3 |
| URPL 665                                | Development and Planning Policies                      | 2 |
| CIVE 601                                | GIS and Geospatial Data Modeling                       | 3 |

A student can take other elective courses from other faculties after securing the approval of her/his advisor.

# Graduation Requirements

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See General University Academic Information in this catalogue.

## Core Course Descriptions

**CIVE 550 Water Treatment and Laboratory 3 cr.**  
A course that examines the quality and principles of municipal and industrial water treatment processes and methods of testing for physical, chemical and biological parameters. (Core Course).

**CIVE 551 Wastewater Treatment and Laboratory 3 cr.**  
A course that examines the quality and principles of municipal wastewater treatment processes and methods of testing for physical, chemical and biological parameters. (Core course)

**CIVE 552 Waste Management and Treatment 3 cr.**  
A course on engineering principles, practices and techniques for the management of solid wastes: sources, composition, properties, impacts, generation, storage, collection and transport, processing, resource recovery, and disposal. (Core course)

**CIVE 553 Environmental Biotechnology 3 cr.**  
A course that examines current and emerging environmental biotechnologies used for environmental quality evaluation, monitoring and remediation of contaminated environments, and provides students with working knowledge of the science that underpins them (Core course)

**CIVE 555 Air Quality Management 3 cr.**  
A course on the principles, practices and techniques for the management of air pollution: Types, sources, properties, impacts, standards, control technologies, atmospheric dispersion, emissions and indoor air quality. (Core course)

**CIVE 654 Environmental Bioremediation 3 cr.**  
A course that discusses the application of biological treatment for the remediation of contaminated environments, and highlights current engineering methods/design used to enhance biodegradation. (Core course)

**CIVE 655/ ENSC 600 Air Pollution and Control 3 cr.**  
A course that examines processes and design equipment for the control of particulates and gaseous emissions. *Prerequisite: Consent of instructor.* (Core course)

**CIVE 685 Environmentally Sustainable Renewable Energy Sources 3 cr.**  
A course that covers basic principles, potentials and limitations of various renewable energy sources and technologies, including solar energy, hydroelectricity, wind energy, bio-energy, fuel cells, batteries and supercapacitors. Sustainability and impact of renewable energy sources on the environment will be discussed. *Prerequisite: CIVE 251 or CHEM 202.*

**LDEM 301      Urban Greening      3 cr.**

This course allows students to develop an understanding of nature in cities, present the latest research and concepts on urban nature, describe and conceptually apply urban greening approaches, explore urban residents' relation with nature, and discuss opportunities and limitations of urban greening in restrictive environments. Graduate or senior undergraduate standing (core course).

**LDEM 302      Green Infrastructure for Resilient Landscapes and Cities      3 cr.**

Green infrastructure is an ecologically based system, naturally occurring or engineered, across urban and rural contexts, that is multi-functional and delivers essential cultural, social, environmental, ecological and economic benefits. It requires a holistic and systems approach to improving ecological function while providing vital ecosystem services for human populations. The course introduces students to the concepts, theories and applications of design, planning and policy of green infrastructure in conjunction with open space planning and design. A particular focus is the relationship and synergy between green infrastructure and climate change adaptation of landscapes and cities. A case study approach is utilized to study green infrastructure across multiple scales, disciplines and applications in the Middle East and North Africa (MENA) region. Green infrastructure is inherently multi-disciplinary and intersects with landscape architecture; urban design and planning; architecture; environmental engineering; public health; urban policy; and environmental policy. Graduate or senior undergraduate standing (Core Course).

**LDEM 630/      Natural Resources Management      3 cr.  
ENSC 630**

This course introduces students to key concepts in ecosystem-based natural resources management (NRM) and to the management of specific terrestrial resources: soils, water, land and biodiversity with examples drawn from drylands and developing nations. A landscape lens is adopted to examine territory-scale resource management options, such as farming, ecotourism, forestry and rangelands. The course also addresses the physical, socioeconomic, cultural, political and geographic specificity of NRM by reviewing the status of Arab Natural Resources in a changing environment (Core Course).

**ENSC 640/      Toxicology and Environmental Health Hazards      3 cr.  
ENHL 310**

The course presents toxicology in three sections. In the first section, the fundamental principles and essentials of toxicology are introduced, particularly dose-response, toxicokinetics, and cellular mechanisms of action. In the second section, the course discusses toxicity of main organ systems. Classic toxicants that adversely affect health, emerging hazardous human exposures, and special topics, are discussed in the last section of the course. The course includes lecture style presentations, collective case-studies activities, and student led discussions. Topics of local and regional relevance are also introduced through hosting guest speakers (Core course).

**ENSC 641/      Occupational Health      3 cr.  
ENHL 312**

This course overviews the general principles of occupational health, relating work, the work environment, and workers' health and wellbeing to general principles of social equity and justice. The course surveys research on the social, economic, political, environmental, and health elements of a workplace using multidisciplinary approaches. Students who join the course are able to identify occupational hazards and work-

related injuries and illnesses in workplaces and propose monitoring, management and prevention strategies to lessen their impact on workers. With its emphasis on social justice, the course discusses the factors that make some workers' groups more vulnerable than others. Its unique approach emphasizes global perspectives and popular imaginations of workers through academic publications, newspaper journalism, cinema, lectures and class discussions. This course is designed for students of multiple educational and training backgrounds and does not require prerequisite knowledge (Core course).

**ENSC 642/ Environmental Management Systems 3 cr.**  
**ENHL 314**

The implementation of an Environmental Management System (EMS) integrates the precautionary and polluter pays principles into firms' operations and demonstrates commitment to sustainable development. This course provides an overview of the most common international standards for environmental management systems, primarily the International Organization for Standardization (ISO) harmonized management systems, and its implications for different organizations. It provides students with the skills to formulate and evaluate such management systems. Though the first part of the course is mainly lecture based, student participation in the form of questions and discussion is always welcomed and encouraged. Critical thinking will be promoted throughout the course. Students will be expected to formulate an EMS for an organization and prepare a technical report to communicate project findings to their colleagues through verbal presentation. Emphasis is placed on solving environmental problems using an integrated management approach in order to achieve an optimized environmental performance. Alternate years (Core course).

**ENSC 650/ International Environmental Policy 3 cr.**  
**PSPA 316**

A course that seeks to provide a broad overview of the key concepts, actors and issues related to global environmental policy. This course outlines the evolution of environmental policy in facing global environmental challenges and how such policies have become inherently intertwined with government policy, business practice and international trade. *Annually.* (Core course).

**ENSC 695 Comprehensive Exam 0 cr.**

**ENSC 697 Project 3 cr.**

The project must be undertaken, in partial fulfillment of the requirements for the degree, upon the completion of at least 27 credits of core and elective courses. A student who is unable to finish the project in one term can register one additional time.

**ENSC 699 Thesis 6 cr.**